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A RAND NOTE

TOW Missile System Utilization at the
National Training Center

Martin Goldsmith

October 1990

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This Note reports on one phase of an ongoing project, the goal of which is to apply the experience and information gained at the National Training Center (NTC) at Fort Irwin, California, to problems beyond the NTC's mission of training. The problem examined here is the use of the tube-launched, optically tracked, wire-guided (TOW) missile system in Echo company of the mechanized infantry battalion task forces at the NTC. The study team examined the relative effectiveness of the TOW missile and tank main guns and compared the result with the experience of the opposing force (OPFOR) antitank guided-missile (ATGM) unit. Differences are clear, and the team analyzed both OPFOR and U.S. Army tactics for the use of ATGM and the characteristics of the equipment to explain the differences. To exploit the TOW weapon systems in the attack, AirLand Battle doctrine requires speed and agility of the carrier that matches that of the other maneuver elements. As the improved TOW vehicle (ITV) carrier cannot meet this requirement, the author suggests that the U.S. Army consider replacing its ITV carriers with M3 Bradley vehicles to provide greater speed and maneuverability to the antitank company. At the same time, doctrine must be rewritten so these characteristics can be exploited and aligned with AirLand Battle. 23 pp. Ref.

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**TOW Missile System Utilization at the
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PREFACE

This RAND Note reports on one phase of an ongoing project at the Arroyo Center. The goal of the overall project is to apply the experience and information gained at the National Training Center (NTC) at Fort Irwin, California, to problems beyond the NTC's mission of training. Relevant matters might be doctrine, materiel development, or other factors for which the NTC "laboratory" can offer data and insights otherwise unobtainable.

Other Notes in this series have dealt with methodologies for research using the NTC data system,¹ the problem of fratricide by indirect and direct fire as observed in training engagements,² tactical reconnaissance as practiced by the Blue training forces and the opposing force (OPFOR),³ and the accuracy of artillery fires.⁴

The problem examined here is the utilization of the tube-launched, optically tracked, wire-guided (TOW) missile system in Echo company of the mechanized infantry battalion task forces at the NTC. The study team examined the relative effectiveness of the TOW missile and tank main guns, and compared the result with the experience of the OPFOR antitank guided-missile (ATGM) unit. Differences are clearly apparent, and the team analyzed both OPFOR and U.S. Army doctrine and tactics for the use of ATGM and the characteristics of the equipment to explain the differences. Conclusions and recommendations are made for improving the effectiveness of Echo company.

¹N-2461-A, *Utilizing the Data from the Army's National Training Center: Analytical Plan*, R. A. Levine, J. S. Hodges, and M. Goldsmith, The RAND Corporation, June 1986.

²N-2438-A, *Applying the National Training Center Experience: Incidence of Ground-to-Ground Fratricide*, M. Goldsmith, The RAND Corporation, February 1986.

³N-2628-A, *Applying the National Training Center Experience: Tactical Reconnaissance*, M. Goldsmith, and J. S. Hodges, The RAND Corporation, October 1987.

⁴N-2984-A, *Applying the National Training Center Experience: Artillery Targeting Accuracy*, M. Goldsmith, J. S. Hodges, and M. L. Burn III, The RAND Corporation, April 1990.

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The Army sponsor for the NTC research project is the Combined Arms Training Activity (CATA) at Fort Leavenworth, Kansas.

Army Regulation 5-21 contains basic policy for the conduct of the Arroyo Center. The Army provides continuing guidance and oversight through the Arroyo Center Policy Committee, which is co-chaired by the Vice Chief of Staff and by the Assistant Secretary for Research, Development, and Acquisition. Arroyo Center work is performed under contract MDA903-86-C-0059.

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SUMMARY

BACKGROUND AND OBJECTIVE

During repeated training battles at the National Training Center, it was often noted that the TOW antitank guided-missile (ATGM) weapon systems, mounted on Improved TOW Vehicles (ITV) of the Blue force Echo (antitank) company, were not as heavily engaged as were tanks and infantry fighting vehicles. Review of NTC Take Home Packages (written for post-rotation study) revealed that comments to that effect were often recorded by the trainers. Articles in the professional journals suggest that TOW gunnery training is a continuing problem, requiring constant attention by unit commanders. However, many of the TOW difficulties seen at the NTC are not with gunnery, but with positioning and mission utilization, particularly in offensive missions. Therefore, this study concentrates on the use of TOW weapon systems in the offense.

TOW KILL DATA

Take Home Package data were used to establish the relative rates of opposing force (OPFOR) armor vehicle kill by TOWs and by tanks. It was found that tanks attained a substantially greater rate of kill. Use of similar OPFOR kill data to compare the experience of their AT-5 ATGM battery with that of the T-72 tanks revealed that the AT-5s proved to have a slightly higher kill rate than the tanks.

MODES OF TOW UTILIZATION

These results prompted the study team to compare the mode of TOW utilization chosen by Blue force commanders, as revealed in their operations orders, with the methods used by OPFOR commanders. Significant differences were found. In particular, the OPFOR exploits the speed and agility of their wheeled ATGM carriers. The OPFOR will use the AT-5s on the flanks of a regimental attack, both for screening and to form on fire lines in support of assaulting elements. The Blue forces usually place the TOWs at the rear of their formations, with the mission of providing overwatch.

DOCTRINAL REVIEW

Current Army warfighting doctrine is AirLand Battle (ALB), which emphasizes maneuver warfare and mobility, particularly in the attack. A review of doctrine reveals little guidance for the use of TOW in the attack. Most discussion of TOW centers on its use as a defensive weapon. Moreover, overwatch, the mission most often associated with TOWs in the attack, is being reexamined by others for its applicability to current conditions.

CONCLUSIONS

To exploit the TOW weapon systems in the attack, AirLand Battle doctrine requires speed and agility of the carrier matching that of the other maneuver elements. As the ITV carrier cannot meet this requirement, we conclude that the U.S. Army might consider replacing its ITV carriers with M3 Bradley vehicles to provide greater speed and maneuverability to the antitank company. At the same time, doctrine must be rewritten so these characteristics can be exploited and come in alignment with AirLand Battle.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Captain (P) Glenn L. Burch and Lieutenant Colonel Donald R. Johnson of the U.S. Army for sharing their accumulated TOW experience and wisdom. Their insights were invaluable to the conduct of the study, and they read and commented on an early draft of the manuscript. The staffs of the Armor School at Fort Knox and the Infantry School at Fort Benning also provided useful comments, as have the staff of the Center for Army Lessons Learned (CALL) at Fort Leavenworth.

The cooperation of Echo Company of the 1st Battalion, 52 Infantry (mechanized), a unit of the NTC OPFOR, was essential and was given with characteristic OPFOR generosity and hospitality.

James House of the RAND staff participated with the author during the field studies.

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I. INTRODUCTION

BACKGROUND AND OBJECTIVES

The TOW is a tube-launched, optically tracked, wire-guided anti-armor weapon system. It can be launched from a ground-mounted unit or from a Bradley infantry fighting vehicle. Light or motorized divisions are equipped with High-Mobility Multi-Purpose Wheeled Vehicle (HMMWV) TOW launchers, and mechanized infantry battalions are equipped with Improved TOW Vehicles (ITV), an M113-based, turreted TOW launcher.

The TOW maximum range is 3750 meters. The gunner must maintain the sight picture during the flight of the missile, particularly near the time of impact. The Multiple Integrated Laser Engagement Simulator (MILES) training device used at the National Training Center (NTC) also requires that the gunner maintain a correct sight picture during a 10-sec simulated time of flight in order to "kill" a target.

No single event or set of observations prompted this examination of TOW effectiveness as exhibited in battles at the National Training Center. Rather, repeated observations of training rotations, together with examination of NTC data and many conversations with NTC personnel, led to an untested belief that utilization of the TOW weapon system could be greatly improved. The purpose of this analysis is first to examine that hypothesis and second to propose remedies if the belief is substantiated.

One set of complaints concerning TOW utilization at the NTC involved gunnery problems. The U.S. Army Infantry School at Fort Benning, Georgia, is devoting considerable attention to this issue, which can be categorized by hit probability.[1] Another class of problems revolves about the doctrinal employment of TOW. The latter problems can lead to insufficient volume of fire or to non-optimal placement of fire, the subject of this research.

Our attention was first drawn to TOW utilization during observations of a rotation in 1985. In several battles, both offensive and defensive, the mechanized infantry task force made very effective

use of their TOWs. What struck us was that this Echo company (the TOW unit) seemed to carry a greater part of the battle than we were accustomed to seeing in other rotations. Subsequently, the Echo company commander of that battalion co-authored an article for *Infantry* describing the company's organization and methods.[2] By that time, the commander was assigned to the NTC as an observer/controller (O/C) and we had the benefit of many useful discussions with him.

We began looking through NTC data, seeking discriminators between those battles in which the TOWs were effective and those in which they were not. We found that there were frequent O/C comments that Echo company had not influenced the battle, but it was rare for the reverse to be stated. However, the Take Home Packages offered us little guidance in determining specifically what might underlie the problem. The most revealing comment could be paraphrased, "The TOWs didn't get into the battle." These comments were most often made concerning task force offensive actions. In addition, we found feelings (unsubstantiated by data) among frequent observers that TOW utilization on the attack was particularly deficient. We therefore decided to concentrate our attention on the use of TOW in the offense.

ORGANIZATION OF DOCUMENT

In Sec. II, we use data from NTC rotations to establish the rates of kill for TOW as compared with the other major antiarmor weapon, the tank. This comparison provides at least a crude check on the effectiveness of the TOW. It does not exhibit other characteristics of effectiveness such as timeliness or flexibility of employment; thus, too much should not be read into such comparative data. We also collected and analyzed similar data for opposing force (OPFOR) tanks and AT-5 anti-tank guided missiles. Our reasons will become apparent later.

In Sec. III, we examine the modes of utilization of TOW in attack scenarios by reviewing battalion operations orders as found in the NTC data archives at the Army Research Institute/Presidio of Monterey (ARI/POM). This information shows the actual practice of Forces Command (FORSCOM) training units. As a comparison, we also describe the methods

used by the OPFOR in the employment of the AT-5 (replica) weapon system, which resembles the TOW in technical capability. It will become clear that significant differences exist in employment technique.

To try to establish the roots of these differences, in Sec. IV we review U.S. Army doctrine for the employment of TOW. We find that little attention is given to the use of TOW in the attack; that fact may underlie the feelings of some Army personnel that the TOW is primarily a defensive weapon.

The document closes in Sec. V with a summary of the lessons learned in the study and with suggestions for improvement of TOW operations.

II. TOW KILL DATA

Our objective in this section is to establish some measure, however crude, of the effectiveness of the TOW weapon system in battles at the NTC. The most obvious measure of effectiveness of a weapon is the kills that it achieves.

We have not used data from the live-fire training engagements because it is customary for the TOW weapon to be replicated by MILES (just as in force-on-force training) while the other weapons shoot live ammunition. We therefore felt that live-fire data might be misleading in some unknowable fashion.

DATA SOURCES

There are two records of force-on-force kill information in the NTC data base. The first is the detailed record available from the instrumentation computer, which in principle displays the shooter, the target, the range, and the time and location of the engagement. Unfortunately, these data exist largely in theory; in practice, owing to technical problems, the instrumentation is able to capture only a fraction of the actual kills.

The other source of kill data is the written Take Home Package (THP), which contains data tables of kills for each battle. These data are gathered by the O/Cs after each battle from the MILES instrumentation boxes on each combat vehicle. The MILES box will show the kill code for the type weapon that triggered the MILES. The Take Home Package tables show which vehicles were killed by which weapons; data for both Blue force and OPFOR kills are included. A deficiency of this data source, in terms of TOW kills, is that the MILES does not distinguish between TOWs fired from ITVs, AH-1s, Bradleys, and so forth. Sometimes, the O/C will know this information; other times, he will not. Thus TOW kills may be lumped together. In spite of this problem, we have used the Take Home Package data for our investigation.

MEASURES OF EFFECTIVENESS

It is not possible to make an absolute scale of effectiveness for TOW kills; the issue is obviously scenario-dependent. All we can do is compare the killing effectiveness of TOWs with that of other weapons over a collection of scenarios. Because the TOW is an antiarmor weapon, we have compared it to the other major armor killer on the battlefield, the tank main gun.

The data taken are simple. We counted the kills of all enemy armored vehicles credited to tanks and to TOWs in the Take Home Package tables. We kept count of the number of tanks and ITVs that began each battle. As a measure of effectiveness, we took the ratio of kills by tanks, per tank, and of kills by TOWs, per ITV. This overstates the effectiveness of the ITV, because ground-mounted TOWs and Bradley- and Cobra-launched TOWs may be included in the TOW figures. We attempted to sort this out in a limited fashion by separating out rotations that include Bradleys (fully modernized units)¹ from those which do not. In both cases, we show separate results for offensive and defensive battles. We do not differentiate between mechanized infantry task forces, which have the Echo company, and the armor battalion task forces, which may have only a platoon (or less) of ITV attached from their sister mechanized battalion task force.

The data were taken for 16 task forces (90 battles) over nine rotations in FY 1988 and 1989. Data for modernized task forces are shown in Table 1. Non-modernized task force results are given in Table 2.

Before continuing the analysis, we make an important point. Owing to systematic scenario differences, *this type of crude data from the NTC must not be used to compare the efficacy of modernized and non-modernized task forces*. In particular, the reader must recognize that

¹A non-modernized mechanized infantry battalion is equipped with M113 armored personnel carriers, which have only a machine gun mounted on the vehicle. A modernized unit is equipped with Bradley infantry fighting vehicles (IFVs) that are equipped with a TOW launcher as well as a 25mm chain gun and a coaxial machine gun. Both types of battalion have an Echo (antitank) company equipped with ITVs.

the influence of the Bradley IFV as an armor killing system is not accounted for in the tabulations, except as they use their TOW.

ANALYSIS RESULTS

The data do make one unequivocal point--the kill ratio for TOW is consistently substantially lower than that for tanks over both types of battle and both types of task force. However, this in itself is only a fact; the implication of the fact requires further analysis. We should not necessarily expect that the TOW will achieve the kill ratio of the tank. For example, it cannot match the rate of fire of a tank, nor can it shoot on the move.

Table 1

WEAPON SYSTEM KILLS: MODERNIZED TASK FORCES

Item	Kills/ITV	Kills/Tank
All battles	0.57	0.90
Defenses	0.56	1.08
Attacks	0.58	0.82

Table 2

WEAPON SYSTEM KILLS: NON-MODERNIZED TASK FORCES

Item	Kills/ITV	Kills/Tank
All battles	0.53	0.92
Defenses	1.14	1.49
Attacks	0.40	0.78

Lacking absolute norms, we must seek some other means of judging the meaning of these data. As we have done in prior studies in this project, let us turn to the OPFOR. There is an organic AT-5 (a Soviet antitank guided missile, similar to the TOW) battery in the motorized

rifle regiment. The battery consists of nine weapon systems mounted on BRDM (wheeled) vehicles, plus command and control vehicles. The OPFOR replicates this company with VISMOL HMMWVs equipped with TOW. The TOW thermal sight is not available to the OPFOR. The AT-5 battery usually participates in regimental attacks, and a platoon of three vehicles is often, but not always, employed during motorized rifle company and battalion defenses. From the Take Home Package data, we have prepared Table 3, which covers 38 OPFOR battles.

Table 3

WEAPON SYSTEM KILLS: OPFOR

Item	Kills/AT-5	Kills/Tank
Defenses	1.50	0.81
Attacks	0.47	0.39

Here we have a reversal of the data from the training battalions. The OPFOR ATGMs show a higher kill ratio than the tanks.² No one has ever suggested that OPFOR tank crews lack aggressiveness or gunnery skills; the data suggest that the AT-5 crews match or exceed the tank crews in those qualities. Again, direct comparison between the absolute values of data in Table 3 and in Tables 1 and 2 is improper, in part because of the differing target environments and in part because of the

²Major Luze of CALL has kindly provided us with the results of a similar examination of THP data that he made covering 22 rotations in fiscal years 1988 and 1989. His figures suggest that the OPFOR AT-5s achieve only the same rate of kill as do T-72s in the defense, while the

large fraction of OPFOR combat power resident in the BMPs (infantry fighting vehicles).³

We make the point here that the OPFOR AT-5 launchers are TOW MILES units, with the same operating characteristics as those used by the Blue force. The OPFOR does not have thermal sights. Likewise, the general characteristics of the OPFOR T-72 main guns are similar to those of the

Blue force TOWs in the attack are even less effective than indicated in our more limited sample. His data are summarized in the table below.

BLUE FORCE DATA

Item	Kills/ITV	Kills/Tank
Defenses	0.851	1.703
Attacks	0.254	0.623

OPFOR DATA

Item	Kills/AT-5	Kills/Tank
Defenses	0.718	0.720
Attacks	0.455	0.398

The conclusion from these data is the same as from our own. OPFOR ATGMs are as effective as their tanks in achieving kills, whereas Blue force ATGMs are substantially less effective than the Blue tanks.

³In a typical regimental attack, for example, the OPFOR might use 40 tanks, 9 AT-5s, and 100 BMPs. A Blue force mechanized task force might have 28 tanks, 26 Bradleys, and 8 ITVs. The tank to antiarmor ratio is similar, but not the same.

Blue force tank unit in terms of firing rate, although the lethalties are appropriately adjusted. The T-72 fire control (sight) system is that of the M551 Sheridan vehicle and has no thermal capability.

In summary, the only two messages we wish to draw from these tables of kill data are (1) Blue force TOWs kill at a rate somewhat lower than Blue force tanks,⁴ and (2) OPFOR AT-5s kill at a rate substantially greater than OPFOR tanks. In Sec. III, we will examine the usage of ATGMs by the training forces and the OPFOR to see if reasons for this difference are apparent.

We have no indication that ammunition capacity is a factor in these findings.

⁴This lower TOW kill rate includes the contributions of some Bradley-launched and Cobra-launched TOWs. Thus, the ITV contribution is even less than these data indicate.

III. MODES OF UTILIZATION

We wish to examine in some organized fashion how the TOW is used by the training task forces. Sources of data are limited. Although it is possible to replay the instrumentation tapes of battles using the computer facilities at RAND, the record reveals only what happened, not what was intended to happen. (Needless to say, these are not necessarily coincident at the NTC.) However, the intent of the plan should be included in the operations orders of the task forces, which are archived at ARI/POM. We therefore reviewed the orders file for the same cohort of rotations in our compilation of kills discussed in Sec. II. In this case, we report only the results for offensive missions.

REVIEW OF OPERATIONS ORDERS

In each order, we looked for specific items of information. First, the organization of the TOW assets was of interest. Doctrine does not preclude the Echo company from being the basis of a company team; however, in the 44 battles reviewed, this was done only once. (In two additional battles, no written order was provided.) For armor battalion task forces, the platoon organization was used, since these forces have no Echo headquarters. For mechanized infantry task forces, the TOWs generally remained under Echo company control. In four of the battles (out of 34 total), the mechanized task force organized the TOWs by platoon, generally in support of another company team. Thus, the organizational aspects of the orders contain no surprises.

We next reviewed the missions given to the TOW assets. We divided the possibilities into four broad categories: to provide (1) overwatch; (2) support by fire; (3) attack from the flank; or (4) a screen. Thirty-two percent of the orders specified an overwatch mission; no flank attacks were included; the screening mission was assigned three times (7 percent); support by fire was assigned 50 percent of the time, with 13 out of 22 instances including specific target instructions, and nine were non-specific. In five battle orders, no mission was assigned at all, only instructions for maneuver.

Maneuver orders could be broadly categorized into three groups: (1) move on the flanks; (2) follow a specific company team; or (3) follow the task force. Fourteen percent of orders specified movement on the flanks; 36 percent called for Echo to follow a company team; 36 percent had Echo following or in the middle of the task force; and 14 percent had no specific instructions.

For each of these battles, we reviewed the TOW kill data from the Take Home Packages. After dividing the kill data into three groups--average, well above average, and well below average--we compared the rankings with the characteristics of each mission order. We could find no correlations of significance. However, the written order does not always yield a complete picture of what the unit will actually do. Many details emerge in the orders briefing and the rehearsals and brief-backs that follow. Therefore, one should not conclude from our lack of perceived correlation that the orders and plans do not matter in the result.

OBSERVATIONS ABOUT OPERATIONS ORDERS

A few summary observations about the orders can be made. In general, units maintain the TOWs under Echo company control but may use the platoons in different areas. The units do not turn Echo into another company combined arms team. Units often place the TOWs behind the task force as it moves. Because task forces will often stretch out as they move forward, it is suspected that this scheme of maneuver can result in the TOWs being out of range when the lead companies would benefit from supporting fires. In a surprisingly large fraction of the orders, the TOWs received little specific instruction. One might suspect that those commanders either do not understand how TOW could be effectively used, or believe that they are of little value in offensive operations. In Sec. IV we will review what doctrine has to say about this point.

OPFOR AT-5

We have another source for insights about the use of ATGMs. The motorized rifle regiment portrayed by the OPFOR battalions at the NTC includes a battery of AT-5 missiles. As previously mentioned, the missile firing system itself is replicated by a TOW MILES training device, whereas the doctrinal BRDM wheeled armored carrier is replicated by a visually modified HMMWV. Three platoons of three carriers each are replicated, together with appropriate command and control BRDMs. The Echo company of the 1st Battalion, 52nd Infantry (mechanized) mans the OPFOR battery. Thus, these soldiers are familiar with their own TO&E ITVs, as well as with the wheeled TOW carriers, which are basically those used by lighter U.S. units [e.g., the 9th Infantry Division (Motorized)]. The data in Sec. II show that the AT-5s are apparently effective in supporting the regiment. How are they employed by the OPFOR?

In the defense, an AT-5 platoon is often used as a reserve to plug penetrations of the defensive system. However, our interest is on their use in regimental attacks. The AT-5 battery is used according to Soviet doctrine, which calls for them to be employed as a flank screen against counter-attack, for example. Additionally, they are used to support other attacking elements through their long-range fires.

The OPFOR allowed RAND researchers to accompany the AT-5s during a number of regimental attacks. While the specifics vary from battle to battle, we found that the battery was usually employed as a unit and, as doctrine suggests, often moved on the flanks of the regiment as it moved. We noted frequently that specific fire lines were to be occupied by the AT-5s, sometimes only on order, to provide support for particular phases of the attack. The most striking observation we made was of the speed and agility of the AT-5 battery. The regiment is known for its rapid and controlled advance; nonetheless, the AT-5s are able to keep up along the flanks, duck into a more central position to support by fire if necessary, and then to return to the flank screen as the attack progresses. We are unable to state whether the actual BRDM carrier has the same degree of mobility as the replica HMMWV, but this mobility is

clearly one of the attributes of the simulated AT-5 battery that permit it to be as effective as it is on the NTC battlefield.

RESULTS OF OPFOR QUESTIONNAIRE

The U.S. Army Infantry School 1 st year circulated a questionnaire to the leaders¹ of the OPFOR antitank battery and the OPFOR staff shared the results with us. For the most part, the questions related to TOW training and utilization. Two of the questions were very pointed and the answers given offer food for thought.

Question 7 was biased in its formulation. It asked, "Why do you feel that TOWs do not influence the battle?" Answers varied in their particulars, but all boiled down to two points. First, respondents disagreed with the thrust of the question, and stated that they felt that TOWs did influence the battlefield. Second, many observed that the Blue TOWs were not effective, but opined that was because Blue did not know how to use them properly.

Question 18 asked, "Based on your experience, what TO&E changes could be made to enhance TOW units' success?" Six soldiers did not respond; two others did not understand the meaning of the question. Of the remainder, six (of nine) suggested that the ITV be eliminated in favor of the HMMWV-mounted TOW. That group included the three responding officers. The interesting aspect of this response is that this unit is required to train on their own TO&E ITVs, while using the M966 HMMWV-mounted TOW for their OPFOR mission; thus, they are familiar with the characteristics of both systems.

We explored with the OPFOR personnel their feelings about the ITV and M966. Their experience indicated to them that the ITV posed a significantly more difficult maintenance problem. This is substantiated by data we took during investigations of scout platoon operations. Data from Ref. 3 show that scout ITVs were available (up) 77 percent of the time at beginning of missions, while M113s were 90 percent available.

¹The questionnaire was intended for grades E-7 and above. It was responded to by four personnel of those grades and 13 other members ranging from E-4 to E-6.

Later unpublished data for wheeled scout platoons showed that the HMMWV were available essentially 100 percent of the time. The key point made by the OPFOR personnel was that the ITV does not have the speed and agility to carry out the tactics they employ with the AT-5 battery. Their opinion (formed on a non-lethal MILES battlefield) is that they would trade the survivability offered by the armor protection of the ITV for the survivability offered by HMMWV mobility. It should be pointed out, however, that their HMMWVs are replicating BRDMs, and are equivalent in MILES hardness to lightly armored vehicles (e.g., the M113). Thus, they may have a sanguine view of the survivability of the HMMWV. It is not clear that they would continue to hold to their opinion if the effects of fragmenting munitions were better replicated at the NTC, and they were not protected from small arms fire.

A point not to be overlooked when considering the AT-5 is that when facing a unit with many heavy lethal armored elements and a small number of light elements, the opponent is apt to fixate on the heavy threat and ignore the dangers posed by the lighter force.

IV. DOCTRINAL REVIEW

According to the data in earlier sections, the OPFOR generally is able to make better use of its ATGMs than the Blue training forces. The OPFOR follows Soviet doctrine, which it may enhance by its own techniques and procedures. An issue that must be addressed is whether U.S. Army doctrine for the use of TOW is being followed by the training forces, and whether that doctrine needs to be supplemented to enhance TOW success.

TOW UTILIZATION IN FIELD MANUALS

Three Field Manuals have been identified that should contain the basis for TOW utilization. These are FM 71-1, *Tank and Mechanized Infantry Company Team*; FM 71-2, *The Tank and Mechanized Infantry Battalion Task Force*; and FM 7-91, *Tactical Employment of Antiarmor Platoons, Companies, and Battalions*. The first manual, FM 71-1, would guide the company team commander to whose unit an antiarmor section or platoon has been attached. The second manual should be a primary source, since an antiarmor company (Echo) is organic to every mechanized infantry battalion. The third manual is the primary doctrinal guidance for all commanders and leaders of the antiarmor units themselves. We have reviewed the latest versions available to us--the November 1988 version of FM 71-1, the September 1988 version of FM 71-2, and the July 1987 draft of FM 7-91. All were published subsequent to the current version of FM 100-5, *Operations*, and should reflect the tenets of AirLand Battle.

Our study of mission orders and field results suggests that it is in the attack that Blue units seem most uncertain about the role of the TOW platoons, and where Blue practice differs most markedly from the OPFOR tactics. Therefore, our review of doctrine has focused on the guidance given for the use of TOWs in the attack. Because our data indicate that the great majority of orders call for the Echo company headquarters to remain in control of the TOWs, the instructions given by

the task force to the Echo company will govern their employment. For guidance, the task force staff will rely on FM 71-2.

FM 71-2

In this key manual, antiarmor units in formations for offensive movement are shown in various placements, ranging from the middle, to the flanks, to the trail of the battalion. The circumstances in which different formations might be preferred are outlined, but no specifics are given to explain the placements of the antiarmor force. Further on, the discussion of supporting attacks on page 3-26 states, "Supporting attacks by fire should come from a different direction than the main attack." But we have seen that this guidance is often ignored in mission orders, when the TOWs are ordered to support by fire but are relegated to the rear of the battalion formation along the main axis. Later, in the section on Synchronization of Offensive Operations on page 3-29, the manual states, "In the offense, the antiarmor company maneuvers to provide overwatch and support-by-fire. Security and economy of force missions are also appropriate." We find that task forces follow this doctrine in that overwatch and support-by-fire (although these two missions are doctrinally distinct, units do not always distinguish between them) are the most commonly ordered missions. The orders are often as terse as the doctrinal statement in offering guidance to the antiarmor leaders.

In speaking of the movement to contact on page 3-46, the manual states, "Antiarmor platoons are used as flank and rear security or are positioned to overwatch the advanced guard." We have seen that task forces seldom position the TOWs far enough forward to provide overwatch to an advance guard, which is one to two kilometers ahead of the main body. One experienced TOW trainer has stated to us that this is, in his opinion, the root of the problem. Realistically, the TOWs would have to be well forward of the main body to provide overwatch.

In its coverage of hasty attacks, the manual states only that the antiarmor force is to provide overwatch or to participate in counterattacks on the flanks of a moving enemy force. There is no more

specificity in the instructions for deliberate attack on page 3-56, where it is stated, "Antitank elements are normally positioned to provide overwatch and support-by-fire onto the objective and potential enemy counterattack routes."

Thus, we see that the actions of task force commanders at the NTC are broadly consistent with the doctrine of FM 71-2. But we also see that some of the more subtle or understated matters of tactics may be ignored or incorrectly applied. In summary, the TOW elements are having relatively little effect on the battlefield when following the broad doctrine. We suspect that the issue of how the overwatch or support by fire is carried out will be the key to improving the situation when the TOWs are used in support of battalion operations. Owing to the limitations on space and assets available for home-station training, it is difficult to hone these tactical skills other than at the NTC. Clearly the OPFOR has the advantage in this regard. That is a good reason to learn from it when we can.

FM 71-1

The other command situation, less often employed, is when platoons of Echo are attached to company teams. In fact, in FM 7-91, it is recommended that the TOWs should be controlled by one person in the battalion, and that task-organizing the TOWs out to the teams "will no longer be the norm." Nonetheless, in some circumstances this might be done, especially in the defense. In this case, the company commander would refer to FM 71-1 for guidance. In the chapter on offensive operations, the manual is silent regarding the employment of antitank elements. However, in the chapter on combat support, there is a section devoted to antiarmor. In the opening discussion, the limitations of TOW and the ITV are mentioned. On the ITV: "It is larger, heavier, and slower than the M113, and much slower than the M2." It is concluded that, "This is not a weapon that can 'shoot and scoot'." We found several points to note in this section. When discussing the security of the ATGM elements it says, "Most importantly, they move behind leading tanks and infantry." (FM 7-91 restates this advice by saying that "TOW

platoons do not lead.") Yet in the next sentence, in the discussion titled "Flank Shots" it is stated, "Ideally, TOW missile squads and sections are positioned to engage tanks from the flank." Surely this guidance could lead to confusion.

In its subsequent discussion of missile standoff, FM 71-1 states that the accuracy of the TOW missile does not drop off with range. While perhaps true in theory, the author of Ref. 4 argues that this is not the case in the typical battlefield situation. This point is important when planning the proper positioning of the weapon system. (FM 7-91 also states that TOW accuracy does not drop off with range, and urges flank engagements against tanks.)

In the discussion of tactical employment, FM 71-1 states that in the offense, ITV platoons would seldom be attached to tank-heavy company teams owing to the incompatibility of the ITV with the tank. What remains unsaid is how the ITVs would be used with a mech-heavy team. In particular, the commander seeking guidance would wonder how he could best use the ITV to supplement his own Bradleys, which are also equipped with TOW missiles.

FM 7-91

Turning to FM 7-91, we found that the discussion of movement techniques (Chapter 3, Section VI) for TOW platoons in the offense was almost always stated in terms of overwatch of other maneuver units, from positions behind the units. In one sentence, the concept of overwatch of flank avenues of approach is introduced, but is not pursued. This topic is further developed in the subsequent section, "Offensive Operations." In Section VII of Chapter 3, discussing movement to contact, it is clearly stated that, "There are two ways the antiarmor platoon can be used in a movement to contact. It can be part of the flank and rear security element, or it can provide overwatch to the lead company." Our review of operations orders has revealed that often this guidance is ignored. Subsequent explanatory material shows the antiarmor providing overwatch from the flanks of the lead unit, and offers the cautionary note that the overwatch positions (in bounding

overwatch) are never forward of the lead maneuver platoon. This section on offensive operations concludes by stating that the antiarmor element is part of the base of fire, but, unlike tank or infantry units, never changes from that role to that of closing with the enemy. The section does not directly point out ways that the antiarmor element can be used to present a different problem to the enemy, as compared with the maneuver units.

Chapter 4 in FM 7-91 deals with the antiarmor company. It is interesting that the entire discussion is based on defensive operations; no mention is made of the role of the antiarmor company in the attack. Clearly, the Echo company commander will have to look elsewhere for guidance. However, the paragraphs on positioning conclude with the admonishment to avoid frontal fires and to engage the enemy from the flank. The arguments for this advice, while intended for defensive operations, apply equally forcefully to offensive operations. We suggest that commanders should not have to read between lines and figure this out for themselves.

V. DISCUSSION AND CONCLUSIONS

Let us review the major points made in prior sections of this study. Data show that in terms of kills per carrier, the TOW weapon is less effective than tanks for Blue task forces. In particular, Take Home Packages and observation reveal that the antitank units are seldom if ever used to great advantage in the attack. On the other hand, data show that the OPFOR ATGM units are very effective and the OPFOR commanders believe the AT-5 serves them well. We have tried to determine the cause of this difference.

Our review of Blue task force operations orders reveals that the mission and directions for the Echo company or antiarmor platoons are often vague and seldom exploit the special virtues of the TOW. On the other hand, the OPFOR uses the AT-5 battery deliberately, securing the flanks and supporting assaults by fire from positions not necessarily coincident with the motorized rifle battalions. Our review of U.S. Army doctrine for the use of the antiarmor unit found that the guidance for offensive placement is vague and lacks clear guidelines. Therefore, it does not seem that the Blue problem is one of failing to follow doctrine, but that the doctrine itself is incomplete. Unfortunately, that shortcoming can lead to lack of emphasis in the schoolhouse and in training.

But the problem is not one wholly of doctrine. For example, the shortcomings of the ITV are discussed in FM 71-1. The ITV could not be used in the same way the OPFOR uses the AT-5; it simply does not have the speed or agility. The ITV was developed for use with the doctrine of active defense, and it may well be a good solution for defensive situations. Even in defense, however, the pace of battle requires speed and agility if repositioning is necessary. It is not well suited for AirLand Battle, which calls for rapid movement to maintain synchronization. One could argue that the Bradley IFVs in the mechanized infantry companies can fulfill the role of the ITV, with its TOW-firing capability. But just dropping the ITV from modernized units

would cut combat capability. A possible solution would be to replace the ITV with the lower cost HMMWV-mounted TOW, which would permit a role complementary to the Bradley in AirLand Battle. The survivability provided by the armor of the ITV would be replaced only by the survivability offered by speed and maneuverability.

Still a different change can be made. The ITVs in Echo company could be replaced by M3 Bradley Cavalry Fighting Vehicles. They enjoy the characteristics of speed and mobility, plus good ammunition-carrying capacity. They also possess the chain gun and machine gun to serve for self defense or other purposes. Their armor protection is at least equal to the ITV, and modernized units are prepared to maintain them.

If that sort of change were made, offensive doctrine for the TOW could be revised. Two recent papers offer guidance in this regard. In Ref. 5, the authors argue for a technique of positioning weapon systems in a defense such that the range capability of each system is exploited to permit the surrounding of kill zones with sources of fire. The object is to achieve surprise and massing of fire. The same logic could be applied to the offense. In Ref. 6, the authors analyze the use of the overwatch doctrine during attacks. They conclude that successive layerings of overwatch by maneuver elements lead to piecemeal attacks and failure to concentrate combat power. They urge the use of artillery and other means to provide the overwatch function. In one interesting statement in their discussion, they speak to the use of TOW: "TOWs can be inserted by foot, helicopter, or infiltrated by wheeled vehicle to provide support from unexpected areas." (We note that weight of ammunition and equipment is apt to sharply limit infiltration by foot.) In another discussion, the authors propose the use of killer tank teams to be dropped off from their parent formation to blunt a counterattack or destroy repositioning forces. This seems to be exactly the role that the OPFOR AT-5 battery plays in its regimental attacks.

We suggest here that if the ITV were replaced with the M3 Bradley in our own Echo companies, our TOW doctrine could be revised to support this different style of use. Rather than emphasizing stand-off range as the prime advantage of the TOW, the doctrine would emphasize the

flexibility of placement afforded by the range of the TOW. Then, the TOW would be used in synchronization with other firing elements to mass fires at the critical time, as well as to perform a "sniper" function against repositioning or counterattacking enemy units. In this mode the TOWs would often advance on the flank of the attacking task force to provide fire from a different direction, and not simply from behind at a slightly greater range along the main axis. These suggestions were made in Ref. 2, where the discussion centered on ITV-equipped units. The authors based their analysis on experience with non-modernized task forces; it is not clear that the ITV could play that role with modernized units. However, the principles are the same, and the M3 is compatible with modernized units.

Note that all these modes require precision gunnery--a difficult training goal requiring intense attention from unit leaders.[7] The topic is unlikely to receive that level of attention unless unit leaders are convinced that the investment will yield commensurate results on the battlefield. Perhaps this is a case where the Army should consider a test of this different employment concept with one of the units that trains at the NTC. If the TOWs yield greatly improved results, vehicular, doctrinal, and training changes could be instituted Army-wide. If some changes are not made, the investment in Echo company will continue to yield less than optimal results in offensive operations.

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